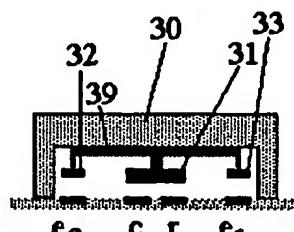


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(71) Applicant (<i>for all designated States except US</i>): NOKIA MOBILE PHONES LTD. [FI/FI]; P.O. Box 86, FIN-24101 Salo (FI).		
(72) Inventor; and		Published
(75) Inventor/Applicant (<i>for US only</i>): RAPELI, Juha [FI/FI]; Fyysikontie 4, FIN-90570 Oulu (FI).		With international search report. Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.
(74) Agent: JOHANSSON, Folke; Nokia Mobile Phones Ltd., P.O. Box 47, FIN-02131 Espoo (FI).		
(54) Title: KEYBOARD AND KEY AND TELEPHONE APPARATUS WITH SUCH A KEYBOARD		
(57) Abstract		
A keyboard having keys for inputting characters, wherein a key is arranged to produce a character in response to the press of the key once. The key (30) has a main contact (31) which is always activated when the key (30) is pressed. Also the key has at least one edge contact (32, 33), which is activated, in addition to the main contact (31), when the key (30) is pressed at the point or close to the point of the edge contact (32, 33). The activation of predetermined contacts correspond to the inputting of a predetermined character.		
		

KEYBOARD AND KEY AND TELEPHONE APPARATUS
WITH SUCH A KEYBOARD

The present invention relates to a keyboard having keys and to a key for inputting
5 characters, wherein the key is arranged to produce a character in response to the
press of the key once. Also the invention relates to a telephone apparatus
comprising such a keyboard.

The use of mobile phones and other portable devices is also becoming common in
10 the handling and transfer of alphanumeric information. This requires having a
small-sized manmachine interface (MMI), which is capable of easily handling more
than 30 letters, numbers from 0 to 9, and about ten special characters (+, #, *,
etc.), i.e., a total of, for example, 50 characters or more. The entity of the
produced characters is called a set of characters. The operational requirement is
15 the same as, e.g., that of a computer keyboard, but the size should be
considerably smaller, and the device should also be suitable for mobile use in
other ways. An additional requirement made of the device is, e.g., good
manufacturability and low costs, as well as suitability for different kinds of user
environments and for the implementation of many different types of sets of
20 characters. The device, presented here, which meets these requirements, is
called a keyboard while an alphanumeric keyboard is called an A/N keyboard.

One way of reducing the size of an A/N keyboard is to reduce the size of an
individual key to the extent that the keys are handled by means of a special
25 manipulator instead of using fingers such as a stick, as indicated by the
development path of the miniaturisation of an A/N keyboard, shown in Figure 1.
Another way is to make one key serial-operationally multi-functioning, i.e.,
sequential, so that, within a specific time window, one press denotes a number,
two presses a first letter, three presses a second letter, etc. For example, an A/N
30 keyboard used with motions, currently in use in GSM phones, functions in this
way, as shown in Figure 2. The keyboard functions merely as a numeric keyboard
and, when separately selected, on an A/N keyboard, so that one press within a

specific period of time (e.g., approx. one second) denotes a first letter alternative, two presses a second letter alternative, etc. In a widely known solution, the sensitivity of a key to the number of presses can be adjusted so that the key either identifies several presses or each press is followed by the main alternative, i.e.,

- 5 usually the selection of a number. The pressing of a key is identified by electronics, so that the pressed key connects a row conductor, at the point of the key, to a column conductor, located at the same point, and by identifying, by means of electronics, the conductors connected to each other.
- 10 The problem of both a traditional and a miniaturised keyboard is that they neither fit in a sufficiently small space nor is it impossible to have clear numeric keys on a small A/N keyboard. From the viewpoint of a portable device, the problem is also the number of matrix conductors, required in keyboard coding, which, for e.g. 56 keys is 7+8 (7 rows, 8 columns), and the deformation of the row/column figure of
- 15 the keyboard, when implementing for e.g., 56 keys physically for a 4*14 row matrix. The advantage of a sequential key function is a clear main function, e.g., numbers, but the disadvantage, from a user's viewpoint, the slowness of the letter functions and that it is difficult to understand.
- 20 A major technical development step should yet be taken from the above-described solutions, e.g., to graphic, interactive keyboards or to identifying writing by a hand movement. Hence, there is still need for a useful A/N keyboard, based on contact.

- One solution for a key of a keypad is disclosed in publication DE 36 22 275, in
- 25 which each key has two contact elements and the key is formed as a rocker button so that when the key is pressed in the middle both contact elements are contacted to activate a middle key function, when the key is pressed at left only the left contact element is contacted to activate a left key function, and when the key is pressed at right only the right contact element is contacted to activate a
 - 30 right key function. This solution allows three different key functions by one press. At the time, however, more than three key functions are desired of one key, especially in mobile phones.

- The present invention combines, from a user's viewpoint, a single- and multi-functioning key so that there is only one key for a number of characters, however, so that each character is selected with a single press of the key. The present
- 5 invention allows in the preferred embodiments 8 - 10 different key functions for each key by a single press of the key. As for its manufacture, the device is economical, because the number of conductors required for keyboard coding such as row and column conductors are smaller than in the well-known two-dimensional matrix conductor solutions. Therefore, e.g., 56 characters, which in matrix coding
- 10 require 15 (7+8) conductors, can be decoded by means of 11 conductors which consist of the row and column conductors of a 4*4 matrix, as well as three conductors identifying the keyboard edge, thereby easily enabling the coding of more than 64 different kinds of characters.
- 15 The invention is characterized by that the key has a main contact which is always activated when the key is pressed, and at least one edge contact, which is activated, in addition to the main contact, when the key is pressed at the point or close to the point of the edge contact, and the activation of predetermined contacts correspond to the inputting of a predetermined character.
- 20 The invention will be described in following by reference to the attached drawings, in which
- Figure 1 shows the development path of the miniaturisation of an A/N keyboard,
- 25 Figure 2 shows a prior art keypad of a mobile phone,
- Figure 3a shows a mechanical principle of the invention,
- Figure 3b shows and a timing diagram of contacts,
- Figure 4 shows contact combinations of triangular and quadrangular keys, and
- Figure 5 shows an electrical principle of the invention and its application.
- 30 Figure 3a shows one example of the structure of a key according to the invention. The mechanical basic structure of a key 30, shown in Figure 3a, is such that a

- centre contact 31 in the key, which is, e.g. of electricity conducting plastic, forms, at first, a contact between c(column) and r(ow) conductors. The centre contact 31 of the key 30 and edge contacts 32, 33... are in an electricity conducting contact with each other and consist of, e.g., a common electricity conducting plastic part
- 5 39. On the basis of this c/r contact, the key that has been pressed is identified on a keyboard consisting of a number of keys. When the key 30 is pressed further, at the point of a corner contact, a second contact is formed, underneath the key, between the centre conductor c and one of the edge conductors.
- 10 When the key is pressed in the centre area, only the c/r contact is formed, which denotes the main character alternative of the key in question. When the key is pressed on one of the edges, at first, the contact c/r is formed and then, after a short expanse of time, a second contact c/e is formed, which denotes the selection of some secondary character alternative of the key in question.
- 15 By means of electronics that identify the functioning of the key, the keyboard can be set to such a mode, that it only identifies the contacts c/r, or the contacts c/r and c/e. It is also possible that electronics can also identify multiple presses. As for timing, it is essential that the contact c/r, and the contact c/e, which could be
- 20 formed after that, will be identified to have formed quickly enough after the formation of the contact.
- One possible identification process is shown in Figure 3b by means of a timing diagram. The contact c/r is formed at the point of time of t_0 , and it is identified by
- 25 the electronic equipment at the point of time of t_{start} . From thereon, the point of time of t_2 will be anticipated, at which time a possible second contact c/e will be identified, and a decision on the key function will be made. When pressing a key in one of the corners, a second contact will be formed at the point of time of t_1 . Thus, the actual difference in time between the contacts c/r and c/e is $t_1 - t_0$, and the
- 30 identification of the entire key function will last for a period of time of $t_D = t_2 - t_0$. Typically, t_D is equal to 50 ms.

- When the key is released, the contact c/e will open at the point of time of t_{31} first and, after that, the contact c/r will open at the point of time of t_{32} , which will be identified at the point of time of t_{stop} . Hence, the duration of the entire key function
- 5 is $T_{tot} = t_{stop} - t_{start}$. Typically, T_{tot} is equal to 100-300 milliseconds. Thus, the key described above makes it possible to produce alphanumeric characters at the rate of three characters a second and, in principle, even as many as ten characters a second.
- 10 As for the method, it is not essential whether contacts 31, 32, 33, etc. are mechanical switches, e.g., well-known membrane keys on a circuit board, or plastic keys as described above. The most essential function is based on one or more contacts and on their order of formation, so that the identification of a character can be made on the basis of the activation of the main contact. This can
- 15 be done in accordance with the example described here, so that all the contacts are assumed to be activated after a specific period of time from the activation of the main contact. A second alternative is that the main contact will be the last to activate, in which case the character can be identified immediately in connection with the activation of the main contact. As for mechanical implementation, the
- 20 former method of implementation is more natural. There are no limitations to the number of edge contacts either, but three and four edge contacts are preferred. Three is preferable because, when one edge is pressing, two other edges form an axle, which supports the inclination of the key and, in addition, the contact part of a triangular key can be pressed in three different ways: only on the centre area,
- 25 on the centre area and on one edge, and on two edges. This enables seven different singletouch characters by means of one key. The eighth character is the pressing of the key, so that all the contacts are activated, i.e., in a triangular key, all binary combinations of edge conductors $E_1 - E_3$ are possible. Four edge contacts are well suited to quadrangular keys, although, e.g., the centre contact
- 30 31 should be used as a support point for the key's movement, if the only aim is to activate one edge contact. In a quadrangular key, the activation of two edge contacts is ideal.

By comparing the easily implemented contact combinations of triangular and quadrangular keys, as shown in Figure 4, it can be noted that a triangular contact part is relatively more effective and almost as versatile as a quadrangular key. In

5 Figure 4, the open circle, drawn inside the key's edge line, denotes an unformed contact and the closed circle denotes a contact formed, by the key being pressed on different points. The contact combinations 1 - 4 of the triangular key, shown in Figure 4, are based on the identification of a centre contact and one edge contact as described above, and the combinations 5 - 8 are based on the identification of

10 a centre contact and two edge contacts On the triangular keys, arrows have also been drawn to indicate the support points of the counterforce to the force forming a contact. It can be seen that the contact combinations 2 - 4 of the triangular key are preferable in the sense that two support points are formed on the opposite edge for each edge contact, and the movement of the key is an easily controlled

15 swaying motion on an axle formed by them.

Figure 5 shows an electrical connection for a 3*3 contact keyboard, wherein each of the keys has three single-press functions. Let us study a key 51, in the centre area, of which there is a row contact of 52 and a column contact of 53, which are

20 connected to a row conductor r_1 , and a column conductor c_1 , respectively. In addition, underneath the key, there is an edge contact of 54, connected to an edge conductor e_1 , and an edge contact 55, connected to an edge conductor e_2 . When pressing the key 51 in the centre, the contacts 52 and 53 connect the row conductor r_1 and the column conductor c_1 together, whereby the control

25 electronics will identify that the key 51 has been pressed. (No contact is formed between the edge conductors e_1, e_2, \dots at this point.) When the key 51 is pressed, e.g., at the point of a contact 54, the key will connect the contact points 52 and 53 and, a little later, also the contact point 54. Electronics will identify that the row conductor r_1 , the column conductor c_1 , and the edge conductor e_1 have been

30 connected together, and interpret that the key 51 has been pressed on the edge, at the point of the contact 54. Thus, a keyboard, according to this example, is capable of identifying 3*3*3, i.e., 27 different characters on the basis of two

contacts formed. More generally, the number of characters N_{tot} , which can be identified by means of a centre contact and, in addition to it, by means of one edge contact, is

5
$$N_{tot} = N_r * N_c * (1+N_e)$$

- where N_r is the number of row conductors, N_c is the number of column conductors, and N_e is the number of edge conductors. Mechanically, it can also be arranged so that, in addition to a contact in the centre area of the key 51, two edge contacts
10 will be activated, in which case, the number of characters to be produced by means of a single press of a single key will increase further. If a large number of special characters should be produced, a well-known method can also be used in order to implement a multi-functioning keyboard and, hence, by means of a single keyboard, also produce, e.g., in addition to the main characters of the Latin
15 alphabet, Germanic and Scandinavian characters.

- In addition to its small size, usability, simplicity, profitability, and economy, the advantages of the solution presented here are also its suitability for a number of different types of sets of characters, as well as for the handling of numbers and
20 letters without mutual limitations.

- To a person skilled in the art, it is also obvious that keyboards can be compiled and used in different ways depending on their use. Sometimes, only one character is identified per key, sometimes all the single-press characters per key, and
25 sometimes, in addition to these, also the characters that require several presses as well. The present solution is also suitable for the implementation of a telephone keyboard in accordance with the recommendations of the CCITT (present ITU). An example of a telephone apparatus in which keyboard according to the invention can be used is a mobile phone, e.g. which is shown in the middle of
30 Figure 1. It is also apparent, that when the contact part of a key is essentially in the shape of a triangle or a quadrangle, as described above, the part that is visible to a user can be designed in accordance with the current requirements or trend. It

is also possible to implement keyboards, which permanently have different types of keys. Thus, the field of application of the present invention is only restricted by the enclosed claims.

Claims

1. A keyboard having keys for inputting characters, wherein a key is arranged to produce a character in response to the press of the key once, characterised in that the key (30) has a main contact (31) which is always activated when the key (30) is pressed, and at least one edge contact (32, 33), which is activated, in addition to the main contact (31), when the key (30) is pressed at the point or close to the point of the edge contact (32, 33), and the activation of predetermined contacts correspond to the inputting of a predetermined character.
5
2. A keyboard according to claim 1, characterised in that the keyboard or keys of its required part can be set by a user to a mode, wherein only main contacts, or all the contacts, or all the contacts and successive functions are identified.
10
3. A keyboard according to claims 1 or 2, characterised in that the key comprises three edge contacts arranged in a triangular form.
15
4. A keyboard according to claim 3, characterised in that the key has a triangular shape and each edge contact is located at an apex of the triangle.
20
5. A keyboard according to claims 1 or 2, characterised in that the key comprises four edge contacts arranged in a quadrangular form.
25
6. A keyboard according to claim 5, characterised in that the key has a quadrangular shape and each edge contact is located at a corner of the quadrangle.
30
7. A telephone apparatus comprising a keyboard having keys for inputting characters, wherein a key is arranged to produce a character in response to the press of the key once, characterised in that the key (30) has a main contact (31) which is always activated when the key (30) is pressed, and at least one edge contact (32, 33), which is activated, in addition to the main contact (31), when the

key (30) is pressed at the point or close to the point of the edge contact (32, 33), and the activation of predetermined contacts correspond to the inputting of a predetermined character.

- 5 8. A key for inputting characters, wherein the key is arranged to produce a character in response to the press of the key once, characterised in that the key (30) has a main contact (31) which is always activated when the key (30) is pressed, and at least one edge contact (32, 33), which is activated, in addition to the main contact (31), when the key (30) is pressed at the point or close to the
- 10 point of the edge contact (32, 33), and the activation of predetermined contacts correspond to the inputting of a predetermined character.

1/2

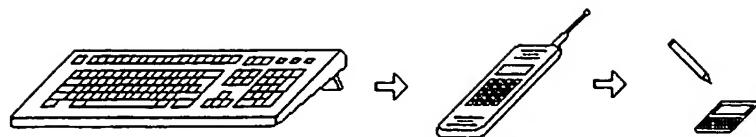


Fig. 1

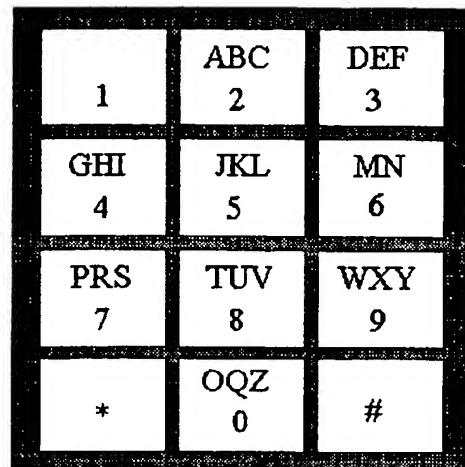


Fig. 2

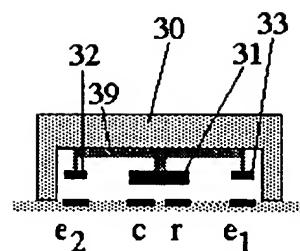


Fig. 3a

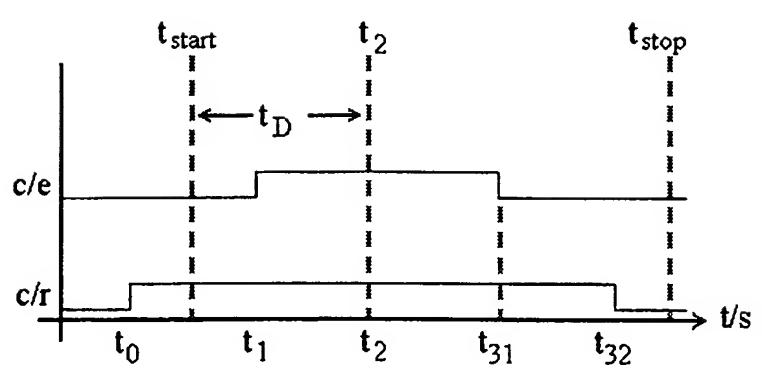


Fig. 3b

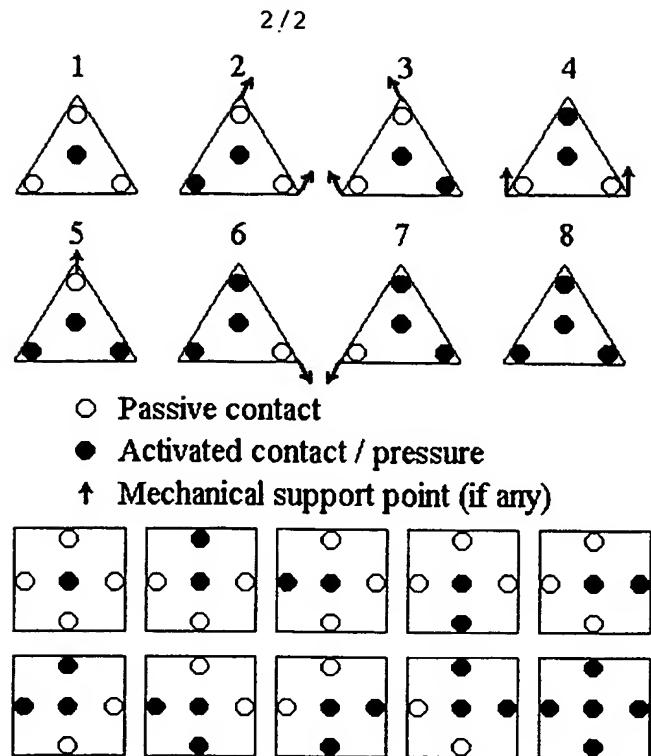


Fig. 4

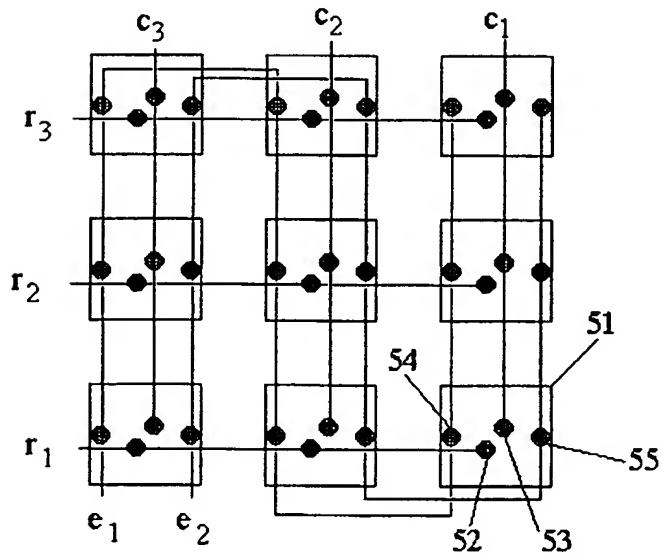


Fig. 5

INTERNATIONAL SEARCH REPORT

International application No.

PCT/FI 96/00404

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: H01H 13/70

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: B41J, G06F, H01H, H04M

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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A	EP 0441993 A1 (INTERNATIONAL BUSINESS MACHINES CORPORATION), 21 August 1991 (21.08.91), figure 10, claim 12 --	1-8
A	EP 0520159 A1 (HOFMANN WERKSTATT-TECHNIK GMBH), 30 December 1992 (30.12.92), figure 6, claim 6 --	1-8
A	GB 2081512 A (SCHOELLER & CO. ET AL), 17 February 1982 (17.02.82), figure 6, claim 5 --	1-8

 Further documents are listed in the continuation of Box C. See patent family annex.

- * Special categories of cited documents:
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- "B" earlier document but published on or after the international filing date
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- "O" document referring to an oral disclosure, use, exhibition or other means
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Date of the actual completion of the international search	Date of mailing of the international search report
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INTERNATIONAL SEARCH REPORT

International application No.

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C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4034176 A (W.A. LARSON), 5 July 1977 (05.07.77), figure 3, abstract --	1-8
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Information on patent family members

28/10/96

International application No.

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